Summary Report: Retroactive Assessment of National Programs 101 and 105

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Mission of the Review Team

Assess how well NP101 and NP105 accomplished their 5-year action plan

What did they do relative
to what they said they
would do

Structure of the Process

- Selection of panel chair (9/05)
- Appointment of panel members (10/05)
- Submission by CRIS leaders accomplishment information to go to NPS (10/05)
- Accomplishment report developed by NPS and submitted to panel (1/06)

Structure of the Process

- Panel briefed on report via teleconference
- Panel met to develop report (2/06)
  - Each component reviewed by a primary and at least one secondary panelist
  - Assessment quantified in terms of impact of the accomplishments (low to high)

Explanation of the Rating System

Rating of Impact:

- Low
- Medium/Moderate
- High

High ≠ Support for problem area

Low ≠ Lack of support for problem area

Low = limited impact observed by review team in given problem area

Overarching Issues

- Need greater collaboration across centers and disciplines
- Avoid scientists conducting research that does not fit the broader scope of the programs
- Need enhanced focus on utilizing strong genetics and genomics infrastructure in studying gene function and regulation

Overarching Issues

- NP101 and NP105 programs should be combined; in doing so, focus on animal welfare should be enhanced
- Enhanced focus on bioenergy was deemed important by panel
  - Rumen microbiology

Assessment of Specific Component Areas

NP101 – Food Animal Production

NP105 – Animal Well-Being Stress Control Systems

NP101

Component I: Reproductive Efficiency

Overview:

- One of the most important measures, female longevity/lifetime productivity, not being addressed

NP101 Component I: Reproductive Efficiency

Problem Area 1A: Environmental effects
Impact: Medium to High

Problem Area 1B: Fertile gamete production
Impact: High

Problem Area 1C: Gamete and embryo storage, cryopreservation, and use
Impact: High

NP101 Component I: Reproductive Efficiency

Problem Area 1D: Embryo, fetal and neonatal development and survival

Impact: Medium

Problem Area 1E: Interactions of endocrine and immune systems

Impact: Low

NP101 Component I: Reproductive Efficiency

- Develop strategies to address problems associated with environmental effects on swine reproduction
- Maintain and (when appropriate) expand diversity of cattle phenotypes
- Use emerging tools in genomic sciences to gain additional insight to the genetic basis for heat tolerance
- Evaluate opportunities and limitations of work with twinning in cattle

NP101 Component I: Reproductive Efficiency

- Develop/implement strategies for continued progress investigating spermatogenesis in mammalian species
- Problem area 1C (Gamete and Embryo Storage, Cryopreservation, and Use) should become part of Germ Plasm component

NP101

Component II: Conservation, Characterization & Use of Genetic Resources

Overview:

- Characterization is most important of three components
- Germ Plasm Evaluation project is model
- Too soon to evaluate success of conservation component

NP101 Component II: Conservation, Characterization & Use of Genetic Resources

Problem Area 2A: Characterizing genetic resources

Impact: High

Problem Area 2B: Conserving and preserving genetic resources

Impact: High

Problem Area 2C: Information systems

Impact: Low

NP101 Component II: Conservation, Characterization & Use of Genetic Resources

- Continue *Bos taurus* characterization work at MARC
- Sheep work seems excessive
- Work in dairy production is needed, especially for functionality traits (including female longevity); new phenotypes needed
- Shift emphasis toward repository of DNA/gametes for genomic studies as opposed to maintaining genetic diversity

NP101 Component II: Conservation, Characterization & Use of Genetic Resources

- Develop contingency plans for re-introduction
- Problem Area 2C (Information Systems) is needed, however does not deserve separate problem area

NP101

Component III: Genetic Improvement

Overview:

- ‘Expected impact’ too general for meaningful evaluation
- A primary role of ARS is development of tools and techniques for use in genetic improvement

NP101

Component III: Genetic Improvement

Overview:

- Area needs complete revision
  - Take into account genome sequence data
  - Suggest health and well being not be separated from accelerating selection response

NP101 Component III: Genetic Improvement

Problem Area 3A: Develop breeding objectives

Impact: Low

Problem Area 3B: Accelerate selection response

Impact: Moderate

Problem Area 3C: Improve health and well being

Impact: Moderate to High

NP101 Component III: Genetic Improvement

Problem Area 3D: Produce and evaluate transgenic livestock and poultry

Impact: Low

NP101 Component III: Genetic Improvement

- Merge Problem Area 3A (Develop Breeding Objectives) with Problem Area 3B (Accelerate Selection Response)
- Include genomics as a component of the selection process
- Need to show productivity in Problem Area 3C (Improve Health and Well-Being); cannot abandon QTL/Marker work
- Phenotypes need to be a focus
  - Divert resources from twinning project
  - Move beyond DHI records

NP101 Component III: Genetic Improvement

- May need to abandon expectation of transgenic production animals due to issues of consumer acceptability

NP101

Component IV: Genomic Tools

Overview:

- Application of genomics to food production is a promising new arena
- ARS has a leading role
  - Breadth of research required
  - Need for extensive development of tools and reagents
  - Significant cost and effort

NP101

Component IV: Genomic Tools

Overview:

- Highlights of efforts:
  - Completion of whole-genome sequences for chickens and cattle (and initiation in pigs)
  - High throughput development of reagents that have facilitated global functional analyses in many species

NP101 Component IV: Genomic Tools

Problem Area 4A: Comprehensive maps
Impact: Very High

Problem Area 4B: Genotyping systems
Impact: Medium to Low

Problem Area 4C: Tools and reagents
Impact: High

NP101 Component IV: Genomic Tools

Problem Area 4D: Genomic enhancement systems

Impact: Medium to Low

Problem Area 4E: Bioinformatics and statistical analysis tools

Impact: Medium

NP101 Component IV: Genomic Tools

- Integrate genome sequences of food-producing animal species with human/mouse
- Shift efforts to functional genomics and utilization of genome sequences
- Problem Area 4B (Genotyping) became less important with sequencing of chicken and bovine genomes
- Coordinate efforts to develop/evaluate microarray reagents and platforms for multiple species

NP101 Component IV: Genomic Tools

- Focus efforts in areas where ARS is positioned to have a lead role
- Avoid redundancy with other public research programs
- Coordinate efforts across ARS and National/Regional project groups to avoid redundancy

NP101

Component V: Nutrient Intake & Utilization

Overview:

- Focus on fundamental research to:
  - Evaluate effects of nutrients and supply of these nutrients on gene expression
  - Identify/manipulate genes that affect efficiency of nutrient utilization

NP101

Component V: Nutrient Intake & Utilization

Overview:

- Decrease research efforts in areas where information about effects on genotype is well established
- Increase cooperation among ARS research locations

NP101 Component V: Nutrient Intake & Utilization

Problem Area 5A: Regulation of nutrient gene function

Impact: Medium

Problem Area 5B: Interactions affecting reproduction

Impact: Medium

Problem Area 5C: Microbial effects

Impact: Medium

NP101 Component V: Nutrient Intake & Utilization

Problem Area 5D: Minimizing production losses

Impact: Medium

Problem Area 5E: Nutrient use and feed evaluation

Impact: High to Medium

NP101 Component V: Nutrient Intake & Utilization

- Increase efforts to evaluate gene expression and regulation as influenced by nutrients
- Expand efforts to include changes in gene expression/regulation related to reproduction
- Focus on determination of fundamental effects of host-diet-microbial relationships
- Avoid projects with limited scope or that are duplicative

NP101 Component V: Nutrient Intake & Utilization

- Define relationships between nutrient intake and utilization and immune function
- Emphasize fundamental research on limitations to utilization of fibrous feeds

NP101

Component VI: Growth & Development

Overview:

- Efficient use of feed is important in economic production and minimizing environmental impacts
- Predominant focus: mechanisms and hormonal/metabolic interactions
- Relationship between increased productivity and decreased welfare

NP101 Component VI: Growth & Development

Problem Area 6A: Regulating food intake

Impact: Low

Problem Area 6B: Tissue growth and development

Impact: Medium

NP101 Component VI: Growth & Development

- Merge Problem Area 6A (Regulating Food Intake) into related research problem areas
- Expand functional genomics aspects

NP101

Component VII: Pre-harvest Product Quality

Overview:

- Extremely important area with high impact and clear goal
- Difficulty – determining attributes that consumers perceive constitute safe, nutritious and wholesome
- Potential for great rewards for agriculture

NP101 Component VII: Pre-harvest Product Quality

Problem Area 7A: Interactions of genetics and nutrition

Impact: Low

Problem Area 7B: Biological Mechanisms controlling variation

Impact: High to Medium

Problem Area 7C: Predicting product quality and defects

Impact: High

NP101 Component VII: Pre-harvest Product Quality

- Problem Area 7A (Interactions of Genetics and Nutrition) could move to Nutrient Intake and Utilization area (Component V)
- Develop production strategies tailored to genotypic difference
- Continue muscle profiling
- Develop new methods predicting quality or defects
- Emphasis on other species (in addition to beef)

NP101

Component VIII: Integrated Systems

Problem Area 8A: User Information Packages

Impact: Low

- Should be merged into other components

NP105

Overview:

- Impressed by scientific output and accomplishments
- Relative lack of depth in some problem areas
- Unclear whether importance is fully appreciated beyond existing leadership of NP105
- Current investment insufficient to warrant six problem areas

NP105

Overview:

- Evidence of stakeholder input to identify issues for planning cycle; unclear whether attention was given to availability of expertise to address gaps, therefore, tendency for areas addressed to align with existing capabilities
- Risk that collaborations, where the focus does not align with interests, will result in less than satisfactory outcomes
- Projects within some problem areas lack focus on genuine analysis of needs

NP105

Problem Area 1A: Scientific Measures of Well Being and Stress
Impact: Low

Problem Area 1B: Adaptation and Adaptedness
Impact: Low

Problem Area 1C: Social Behavior and Spacing
Impact: Low

NP105

Problem Area 1D: Cognition and Motivation

Impact: Low

Problem Area 1E: Practices and Systems to Improve Care and Well-being

Impact: Low

Problem Area 1F: Bioenergetic Criteria for Environmental Measurement

Impact: Low

NP105

Recommendations:

- Combine programs 101 and 105 to achieve mutual benefits
- Provide clear identity for animal welfare
- Reevaluate importance of/investment in animal welfare program/component; consider:
  - Appoint scientists with both required discipline and understanding/training in animal welfare
  - Develop/build international links
- Focus needs to be more strategic, based on needs of industry

NP105

Recommendations:

- Select projects that have animal welfare as primary focus
- Expand focus to include wider community as stakeholder
- Build on international linkages to maximize international research outcomes
- Use science to underpin changes to industry practice

NP105

Recommendations:

- Combine six current problem areas into two, and expand into a third area
  - Scientific measures of well-being and stress
  - Housing and environment to improve care and well-being
  - Producer, customer, consumer and community requirements
- Expand into additional areas only if strategic and if sufficient resources

Summary Recommendations NP101 and NP105

- For the next Action Plan, it is critical that consideration be given to developing long-term, sustainable ventures with greater focus

Summary Recommendations NP101 and NP105

- Admonition: Do not shift emphasis away from long-term industry needs to short-term problems for which developed technologies are often more easily commercialized
- The purpose of NP101and mission of ARS Animal Production programs needs to continue to have a long-term outlook with regard to research focus